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THE MOON

The Moon and the Condition and Configurations of its Surface. By Edmund Neison, F.R.A.S., &c. (London: Longmans, Green, and Co., 1876.)

FROM the earliest ages our satellite has attracted a great portion of the attention of astronomers of all nations, and from its proximity to us it is only right that it should still have a large amount of astronomical labour bestowed on it. This labour is divided into two kinds, that of ascertaining its motions in space, and that of inquiry into its physical constitution. It is of this latter research or the study of selenography, chiefly, that the present work treats. The author tells us that he has taken the "Mond" of Beer and Mädler as a basis, but that the greater portion of the material has been mainly derived from eight years constant selenographical observations, principally made with a 6-inch equatorial of fine definition and with a 9⅓ inch With-Browning reflector. Also, use has been made of some hundred lunar sketches made of late years by different astronomers, and which from time to time have been sent to the author; the work, therefore, is as complete as our present knowledge enables it to be. The first chapter of the book treats of the motions, figures, and dimensions of the moon, and mention is made of the elliptic inequality, discovered by Hipparchus, evection, variation, and annual equation. The alteration in appearance of the lunar surface, due to *libration*, is a matter of the utmost importance in selenography, and the discussion of its effects, together with the formula for computing the same at the end of the book, will be useful to those interested in lunar observations. The author then proceeds to discuss the question of a lunar atmosphere, and his arguments in favour of the same, having a surface-density of $\frac{1}{300}$ that of our air, are extremely forcible. It has always seemed strange that the moon should have had neither air nor water, or almost none, and we are glad to see that it is not incompatible with appearances that a mass of air and water should have existed comparable to ours, when the relative mass of the moon and earth are considered.

The weather-beaten and ruined portions of the moon's surface are referred to as indications of the effects of these agents; and in favour of the existence of an atmosphere, Mr. Neison points out that "it may be reasonably supposed that the ratio of the mass of the primitive lunar atmosphere to the mass of the moon would be a similar ratio to that which obtains on the earth, considering the close connection between the two; but such are the conditions prevailing on the surface of the moon, that so far from the resulting atmosphere resembling in surface-density that of the earth, it would only be $\frac{1}{50}$ as dense, for not only is the surface of the moon as compared with its mass much greater, but the force of gravity at its surface is much less powerful, so that from these causes the atmosphere would occupy a much greater comparative volume, and consequently possess a very small density." One would, at first sight, fancy that $\frac{1}{50}$ was too small a probable estimate, but when we consider that the mass of the moon is $\frac{1}{81}$, that of the earth and its surface $\frac{1}{13}$, we get, per unit of area, $\frac{13}{81}$ of the mass of the terrestrial atmosphere.

The force of gravity on the moon's surface being about $\frac{1}{6}$ of that on the surface of the earth, the pressure of the atmosphere at the surface will be about $\frac{1}{37}$ of the pressure of our atmosphere; correcting this for the probable effects of temperature, we get somewhere about $\frac{1}{50}$ as the surface density. The author explains the absence of water and the disappearance of a great portion of the above small quantity of atmosphere by drawing a parallel between the surface of the moon and earth, and stating that "the joint effect of the action of the terrestrial surface oceans and atmosphere has been to form the present crust of the earth, where is to be found locked up an immense mass of water and of the constituents of our atmosphere which originally formed part of the early terrestrial oceans and atmosphere, and by this means probably a very considerable portion of these must have been by now removed. A similar action would have ensued on the moon with this important difference, that as, relatively to these masses the lunar surface is more than six times as great as the earth's, this absorption of the oceans and of the atmosphere would have been not only more rapid, but have been carried to six times the same extent under the same conditions." The present surface density, he therefore argues, may be now $\frac{1}{6}$ of its original state, or about $\frac{1}{300}$ of the density of that of the earth.

The estimated density of Bessel and others from refraction, of about $\frac{1}{1000}$ of that on the earth, is referred to, coupled with a remark that the temperature was assumed by him to be uniform and a factor depending on the difference of the form of gravity at the surface of the earth and moon omitted, and if correction is made for these, the result should be $\frac{1}{350}$ as the surface density. From observation of occultations it has long been known that a difference of some 2" existed between the semi-diameter of the moon as determined by occultations and that determined by direct measurement; irradiation accounts for a part of this, leaving the rest to be accounted for by horizontal refraction, and this, we read, renders a surface density of $\frac{1}{200}$ of that of the earth's atmosphere possible, but from other considerations the author puts the probable density at $\frac{1}{300}$. The effect of such an atmosphere in mitigating the climate is shown, but it is not quite easy to see from the present evidence that such an atmosphere, having a pressure of about one terrestrial ounce to a square inch, will account for lunar appearances, or even if we take the pressure at one time to have been $\frac{1}{37}$ of that on the earth, or six ounces. This will require future observations to settle. We are inclined to think that the author is rather over-zealous in his cause when he states to the effect that the mass of atmosphere over a square mile in area must be estimated in millions of tons. This can scarcely be the case, judging from the above-estimated pressure. The occultations of stars, the blue halo occasionally seen around isolated craters, and Lord Rosse's experiments upon radiation from the surface of the moon are all discussed. The author, however, candidly acknowledges that no definite results can be obtained from them either one way or the other, but is convinced that the balance of evidence is in favour of an atmosphere of considerable magnitude, although of slight

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density; and "to neglect this is to render nugatory all attempts to explain the phenomena presented by the moon."

In treating of the physical condition of the lunar surfaces, it is pointed out that Beer and Mädler's frequent quotation, "The moon is indeed no copy of the earth, much less a colony of the same," is not so well founded as it would appear to be; for although the first impression gained from the general appearance of the surface is that it contains neither oceans, seas, nor river systems, with the accompanying formation, but a desert containing innumerable craters and surface irregularities, still on a closer investigation with adequate means, more points of resemblance become manifest. The more level regions of the moon, especially the shores, though known to have been long destitute of water, are pointed out as appearing to show many traces of its action, as the formation of diluvial deposits recognised by Sir John Herschel; whilst Prof. Phillips traced many analogies between the apparent volcanic formations of the earth and moon, and found many indications of the action of a disintegrating atmosphere.

The greater craters apparently existing on the moon when examined with powerful telescopes, the author tells us, appear less and less like volcanic orifices or craters; their inclosing walls lose their regularity of outline and form, and appear as confused masses of mountains broken by valleys, ravines, and depressions, crossed by passes, and surrounded by low plateaus and an irregularly broken surface; whilst the seemingly smooth floors generally appear as diversely interrupted as the environing surface. These formations are thus seen in their true character, not as craters, but as low-lying spaces surrounded by mountain regions or disturbed highlands.

The author appears to think that the *ring plains* and *wall-plains* are not volcanoes, in the ordinary sense of the term, but depressions surrounded by mountain ranges, and that the great number of apparently small craters are mere shallow hollows, such as are not uncommon on the earth.

The fact that gentle slopes and valleys, like many of our river valleys, would not, except under most favourable circumstances, be shown in relief, is a matter which may easily escape notice, and is here referred to; and further, any small abrupt feature may cast a shadow completely masking much more extensive formations. Attention is called to the fact that Mädler pointed out that formations possessing a north or south direction are much more easily seen upon the moon than those extending east and west, a peculiarity tending to give an imperfect idea of the true nature of the surface, and accounting in some measure for the general meridional direction of numbers of the smaller formations of the moon, such as the ridges, land-swells, and rills, as matter very noticeable on a glance at a lunar map.

The variation of the appearance of lunar formations during the course of a lunation is very forcibly described, as also is that due to libration. The effects of the changes in temperature are referred to as causing a physical variation of the surface, and the changes in the crator Linné, and the ring-plains of Messier are referred to as probable instances of physical change.

The various formations on the lunar surface are enumerated and described with considerable minuteness. With regard to the rills or clefts, Mr. Neison seems to incline to the belief that the majority of them are ancient river-beds, though at present their nature is purely conjectural.

Some thirty pages are devoted to an abstract of the work done upon the moon by various astronomers from the earliest times; but we find no mention of Nasmyth's and Carpenter's excellent book in this list, a work which surely deserves some notice.

The book, of 576 pages, is illustrated by five drawings of craters, and possesses no less than twenty-two maps, containing together the whole of the moon's surface, each of which is accompanied by a full explanation, taking up at least three-fourths of the book, the scale of the maps being 24 inches to the moon's diameter. Three of the craters—Gassendi, Maginus, and Theophilus, are drawn upon an enlarged scale. This work will, no doubt, be of considerable service to those who make our satellite their chief study, since, besides the objects enumerated by Beer, Mädler, and Schmidt, it contains a large amount of new work.

HOVELACQUE ON THE SCIENCE OF LANGUAGE

La Linguistique. By A. Hovelacque. (Paris: Reinwald and Cie., 1876.)

IN speaking lately of the Science of Language we alluded to the question that is still being debated among its students as to whether it ought to be classed with the physical or with the historical sciences. Its method is that of the physical sciences, while phonology, which forms so integral and fundamental a part of comparative philology, is purely physiological in character. On the other hand, since phonetic sounds do not become language until they have been made significant, the science of language may be regarded as a historical one. M. Hovelacque is a warm supporter of the first opinion, and his book is an attempt to treat the science of language as a physical science pure and simple. In this respect he is a follower of Schleicher, as he is also in applying the Darwinian hypothesis to the history of speech and in holding at the same time that the various languages of the world have branched off from a number of independent centres. His work is a valuable contribution to the literature of the subject.

M. Hovelacque starts with the assertion that man is man solely in virtue of language, or rather of the capability of language. Following M. Broca he holds that this capability is a function of the third frontal convolution of the left, more rarely of the right, hemisphere of the brain, and that it was first acquired by a primate which thereby became a man. A certain number of the same primates, "less favoured by circumstances, were checked in their development, and relapsed into a regressive change of character; their remains are to be recognised in the anthropoid apes, gorillas, chimpanzees, orangs, and gibbons." Those primates which by a process of natural selection acquired the capability of speech and with that the characteristics of man, gradually improved upon their new possession, wherever external circumstances were favourable, and with the development

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